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## **Chimney and periscope grafts to facilitate endovascular treatment of aortic transection in a patient with aberrant right subclavian artery**

Vicente, Sandra ; Glenck, Michael ; Mayer, Dieter ; Veith, Frank J ; Lachat, Mario ; Pecoraro, Felice

**Abstract:** **PURPOSE:** To report the use of parallel grafts to extend the proximal landing zone for stent-graft repair of aortic transection involving an aberrant right subclavian artery (ARSA). **CASE REPORT:** A 28-year-old patient was referred for treatment of traumatic aortic transection with contained rupture at the level of an ARSA. Immediate thoracic endovascular aortic repair (TEVAR) was planned because of hemodynamic instability. To achieve rapid sealing and maintain perfusion to both subclavian arteries, a chimney stent to the left subclavian artery (LSA) and a periscope stent-graft to the ARSA were deployed successfully. After surgical repair of all fractures, the patient was discharged 1 month after the initial injury in good condition. Imaging follow-up at 10 months showed a stable repair, patent parallel grafts, and no complications. **CONCLUSION:** TEVAR with chimney and periscope grafts proved to be a safe and quick treatment for a patient requiring ARSA repair in acute aortic transection. This technique maintained blood flow to the ARSA and LSA in a totally endovascular approach, which could be very valuable in transection cases where bypass surgery to supra-aortic branches is compromised or deemed challenging due to thoracic wall and/or neck trauma. Parallel grafting can be a valuable tool to address any acute aortic pathology as it can be performed with off-the-shelf devices.

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◆ CASE REPORT ◆

## Chimney and Periscope Grafts to Facilitate Endovascular Treatment of Aortic Transection in a Patient With Aberrant Right Subclavian Artery

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**Purpose:** To report the use of parallel grafts to extend the proximal landing zone for stent-graft repair of aortic transection involving an aberrant right subclavian artery (ARSA).

**Case Report:** A 28-year-old patient was referred for treatment of traumatic aortic transection with contained rupture at the level of an ARSA. Immediate thoracic endovascular aortic repair (TEVAR) was planned because of hemodynamic instability. To achieve rapid sealing and maintain perfusion to both subclavian arteries, a chimney stent to the left subclavian artery (LSA) and a periscope stent-graft to the ARSA were deployed successfully. After surgical repair of all fractures, the patient was discharged 1 month after the initial injury in good condition. Imaging follow-up at 10 months showed a stable repair, patent parallel grafts, and no complications.

**Conclusion:** TEVAR with chimney and periscope grafts proved to be a safe and quick treatment for a patient requiring ARSA repair in acute aortic transection. This technique maintained blood flow to the ARSA and LSA in a totally endovascular approach, which could be very valuable in transection cases where bypass surgery to supra-aortic branches is compromised or deemed challenging due to thoracic wall and/or neck trauma. Parallel grafting can be a valuable tool to address any acute aortic pathology as it can be performed with off-the-shelf devices.

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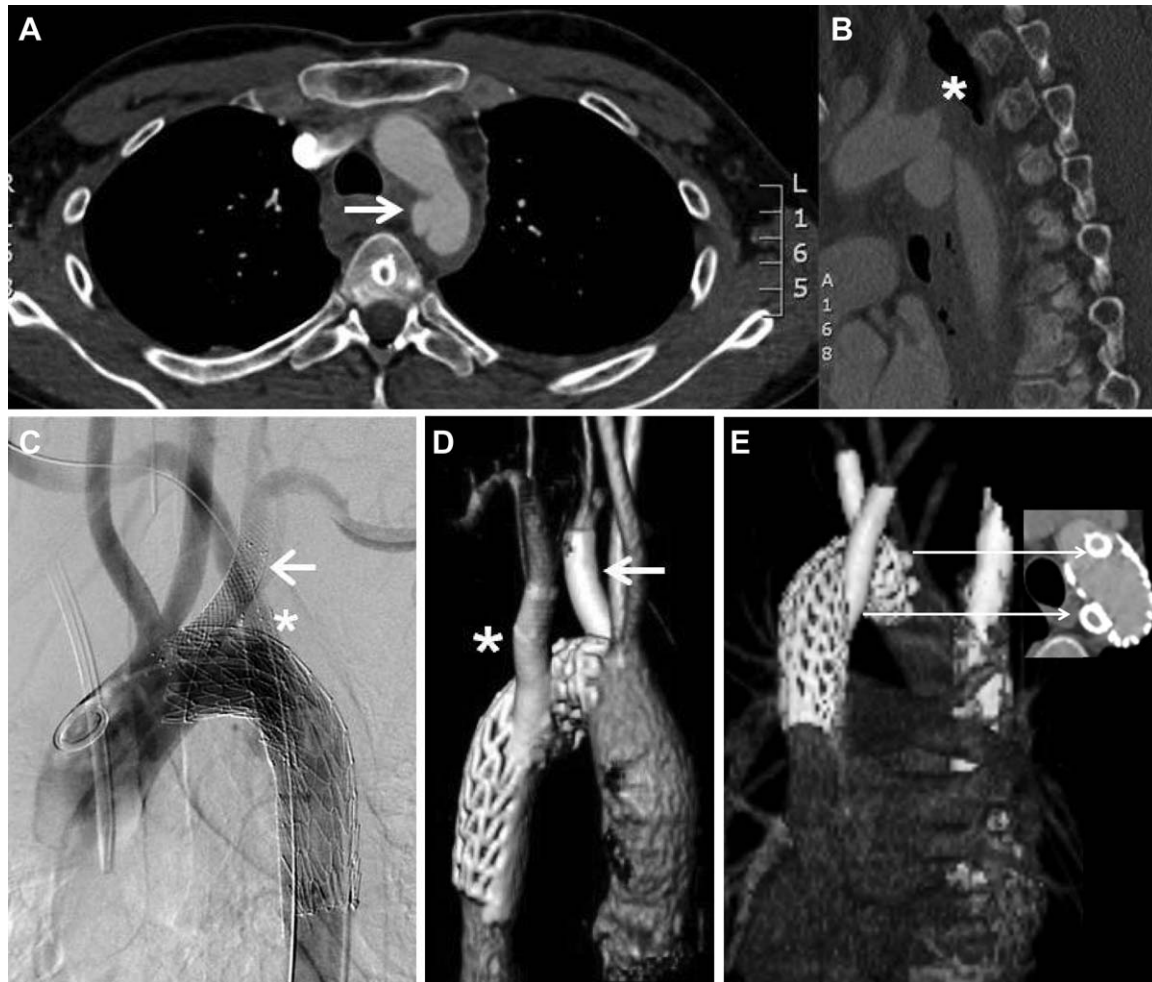
**Key words:** thoracic aorta, aortic transection, trauma, thoracic endovascular aortic repair, aberrant right subclavian artery, left subclavian artery, stent-graft, parallel graft, chimney graft, periscope graft, landing zone  
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Endovascular repair of traumatic aortic transection is an attractive alternative to open repair,<sup>1,2</sup> but there is little experience in patients presenting aberrant right subclavian artery (ARSA).<sup>3</sup> In some of these patients, aortic sealing might require landing a stent-

graft proximal to the left subclavian artery (LSA). In such cases, revascularization of one or both subclavian arteries might be considered. We report an endovascular approach to maintain blood flow to the ARSA and LSA that could be very valuable in transection cases

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**Figure** ♦ Preoperative coronal (A) and sagittal (B) CT scans show the aortic transection (arrow) localized distal to an ARSA origin (asterisk). (C) Intraoperative control angiography showing good anatomical and functional results (asterisk shows ARSA repair; arrow shows LSA stent). (D) Postoperative CT angiography showed complete sealing of the rupture site and unrestricted chimney stent (arrow) and periscope graft (asterisk shows ARSA repair). (E) CT angiography reconstruction (posterior view) performed at 10 months shows patent LSA chimney and ARSA periscope endografts.

where bypass surgery is compromised or deemed challenging due to thoracic wall and/or neck trauma.

## CASE REPORT

A 28-year-old patient was transferred to our tertiary university center for treatment of polytrauma, including multiple bone fractures, thoracic trauma, and traumatic aortic transection in the classic location. Redo computed tomographic (CT) angiography after transport showed an aortic lesion that

seemed to be stable (Figure, A,B), but the patient developed progressive hemodynamic instability. As a consequence, it was decided to treat the transection as an emergency with a minimally invasive technique.

Bilateral percutaneous transfemoral remote accesses were obtained using the preclose technique with Proglide (Abbott Vascular, Redwood City, CA, USA), while remote access to the LSA was achieved with infraclavicular exposure of the axillary artery and a surgiclose technique.<sup>4</sup> After systemic heparin was administered (5000-unit intravenous bolus),

the subclavian arteries were accessed with soft guidewires (J wire; Cordis Endovascular, a Johnson & Johnson company, Miami Lakes, FL, USA) via 8-F and a 9-F sheaths (Arrow International Inc., Reading, PA, USA). The ARSA was cannulated transfemorally using a JB1 catheter (Cook Medical, Bloomington, IN, USA). A 9 x100-mm Viabahn stent-graft (W.L. Gore & Associates Inc., Flagstaff, AZ, USA) was placed in the ARSA, and an 8x40-mm Wallstent (Boston Scientific, Natick, MA, USA) was introduced over a Rosen wire (Cook Medical) and temporarily parked in the LSA. A 28x100-mm CTAG (W.L. Gore & Associates) was introduced through a 22-F Arrow sheath and positioned under fluoroscopy and angiographic control to land just distal to the left common carotid artery. After the aortic stent-graft was successfully deployed at the intended position, the chimney and periscope grafts were positioned precisely and deployed. Full modeling of all stents and stent-grafts was performed with a kissing balloon technique. Nonetheless, both the chimney (Wallstent) and periscope (Viabahn) devices showed significant residual constriction from the aortic stent-graft, which was relieved by additional stenting (8x37-mm Visi-Pro; Covidien, Mansfield, MA, USA). Completion angiography and manometry showed good anatomical and functional results (Figure, C). A low-flow type II endoleak was observed but not treated as the hemodynamics were stable at this stage. The postoperative course was uncomplicated and pre-discharge CT angiography showed complete sealing of the rupture site, with patent chimney and periscope grafts (Figure, D). At 10-month follow-up (Figure, E), the patient was asymptomatic and the CT showed no complications.

## DISCUSSION

ARSA, originating as the most distal aortic arch vessel, is the most common congenital anomaly of the aortic arch, with an incidence of 0.5% to 1.5%.<sup>5</sup> ARSA pathologies have traditionally been treated by conventional open repair, which carries considerable mortality (11% to 24%) even in the largest published series.<sup>6</sup> Recently, hybrid repair has been reported.<sup>5–8</sup> In these hybrid procedures,

endovascular vessel occluders combined with carotid-to-subclavian artery bypass grafting/ or fenestrated and aortic stent-graft deployment were successful.<sup>7–11</sup> Our case illustrates the applicability of thoracic endovascular aortic repair (TEVAR) with chimney and periscope grafts to address traumatic aortic transection in a patient presenting with ARSA. Unlike other cases in which a periscope graft has been used to extend the distal landing zone,<sup>12</sup> we used the periscope to extend the proximal seal zone.<sup>13</sup> This maneuver allowed us to use only one chimney endograft in this area instead of two, which reduced the potential for endoleak and long-term complications. As a technical note, if a pressure drop along the chimney and/or periscope endografts or severe stenosis (~80%) is detected during the procedure, additional branch stenting (self-expanding or balloon-expandable) should be performed.

## Conclusion

TEVAR with the chimney and periscope grafts proved to be a safe and quick treatment in a patient requiring ARSA repair in acute aortic transection. This technique maintained blood flow to the ARSA and LSA in a totally endovascular treatment. Parallel grafting can be a valuable tool to address any acute aortic pathology as it can be performed with off-the-shelf devices.

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